NOTES ON THE INTRODUCED ANT *QUADRISTRUMA EMMAE* (HYMENOPTERA: FORMICIDAE) IN FLORIDA[1]

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ABSTRACT: The Old World tropical ant *Quadristruma emmae* is reported from 28 counties in southern and central Florida, where it occurs in a variety of man-modified and natural, xeric and mesic habitats. Based on its habitat requirements, it is expected to colonize sheltered urban habitats in the southwestern United States. A captive colony caught and consumed entomobryid Collembola. This species, along with the neotropical exotic *Strumigenys eggersi*, are common throughout southern Florida, and may have had local effects on some northern species of dacetines of the genus *Smithistruma* whose ranges extend into central and southern Florida, but these exotic dacetines are not expected to endanger native species of ants. Three males collected in flight traps are believed to represent this species, based on size, and the structure of the mandible and forewing.

The ant *Quadristruma emmae* (Emery) (Fig. 1) is a tramp species known from Florida, the West Indies (specimens reported from the Bahamas: San Salvador, North Andros, New Providence; Cuba; Puerto Rico; and U.S. Virgin Islands: St. Thomas), Africa, India, the Seychelles, Malaysia, Indonesia, New Guinea, Australia, New Hebrides, the Philippines, Guam, and Hawaii (Bolton 1983). It is clearly native to the Old World tropics, where its only congener occurs. Brown (1954) suggested that the species originated in Africa as a lineage derived from the *Strumigenys rogeri* Emery species group. *Quadristruma emmae* is the only ant in Florida (or the United States) whose antennae have only four segments. Other character states useful for identification are the bowed jaws with two apical teeth, the large spoon-shaped hairs with discoid tips on the head (Fig. 1), and the small size (length of worker about 1.4 mm, length of female about 1.7 mm). Outside the U.S., the distinction between *Quadristruma* and the large, diverse genus *Strumigenys* depends primarily on the reduced number of antennal segments in the former genus, and *Quadristruma* may eventually be subsumed into *Strumigenys* (Brown 1954). There is no possibility of confusing *Q. emmae* with any Florida species of *Strumigenys*.

The purpose of this note is to describe the range and habitat preferences of *Q. emmae* in Florida, present some information on its diet and colony composition, consider its possible ecological impact on native species, and describe specimens that are believed to be the previously unknown male.

DISTRIBUTION AND ECOLOGY

Quadristruma emmae is presently confined to southern and central penin-

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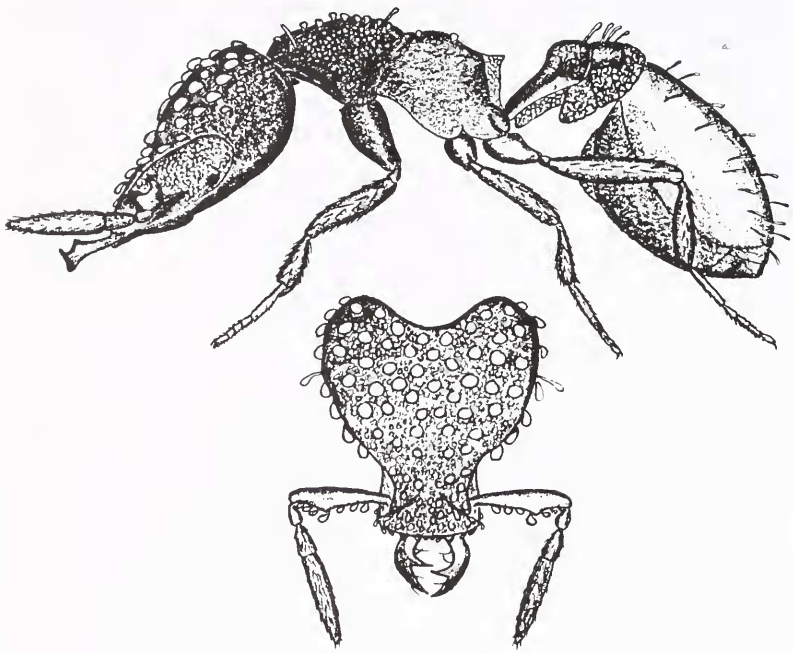

Figure 1. *Quadristruma emmae*, worker.

sular Florida. The site records in Fig. 2 are from a study of litter-inhabiting ants from throughout Florida, including hundreds of Tulgren funnel extractions from sites north of the sites shown in Fig. 2. *Quadristruma emmae* was not found by Johnson in his exhaustive study (1986) of the ants of Alachua County. The distribution of this species in Florida, as well as its world distribution (Bolton 1983), suggest that it will not become a common species in the colder parts of Florida, or elsewhere in the U.S. It is, however, an abundant species in southern Florida areas that are centers of the nursery trade, and it is likely to be transported all over the southeastern U.S. and eventually into the Southwest, where it might establish populations in protected microclimates, especially in urban areas. It may already occur in cities in southern Texas, Arizona, New Mexico, and California, all states with such varied and exciting natural habitats for ants that their anthropogenic habitats may receive less attention. In southern Florida, it has been found in most xeric and mesic sites that have been intensively sampled. Gaps in the distribution map are primarily due to extensive wetlands or problems of access for collecting litter samples.

Quadristruma emmae was first reported in Florida by Brown in 1949. There

is a specimen from Homestead (Dade County), Florida, dated 25 June 1945, in the Florida State Collection of Arthropods. It is next reported forty years later at a site in south-central Florida (Deyrup and Trager 1986), soon after from several sites in the Florida keys (Deyrup et al. 1988), then from 15 Florida counties (Deyrup et al. 1989), and now from 28 counties. Although this history gives the impression of an exotic species that has had a recent, almost explosive increase through southern and central Florida, this impression is probably wrong. The increase in records is probably due to the survey of ants in leaf litter that has been going on over the last 12 years.

Figure 2. Distribution of *Quadristruma emmae* in Florida.

In this survey of litter-inhabiting ants, using standardized, unsifted, approximately 2-liter samples of litter, we found *Q. emmae* in 227 samples at 99 sites. The sites were roughly categorized as xeric, mesic, or wet. Of the sites that had *Q. emmae,* 39 were xeric, 49 were mesic, 11 were wet. The sites were also roughly categorized as highly modified by human activity, somewhat modified, and unmodified. Highly modified areas included planted areas, such as mulched hedges along shopping malls, avocado groves, dense stands of exotic trees, and all urban sites. Somewhat modified areas include those that are adjacent to large roads, or have some soil disturbance, or an admixture of large exotic plants, and most suburban sites. Unmodified areas are natural plant communities, including some unburned Florida scrub and sandhill sites; even though fire suppression might be considered a type of modification of natural habitats, there were probably always some patches of these xeric forest types that went an unusually long time between fires. Of the sites that had *Q. emmae*, 28 were highly modified, 29 were somewhat modified, and 42 were unmodified.

Habitat types were also assigned to these collecting sites. The sites with *Q. emmae* were distributed among the following habitats:

39 – xeric forest (old growth, long unburned Florida scrub and sandhill)
22 – mesic forest (oaks, often with pines; plantings of large exotic trees; riparian forest)
13 – tropical hardwood hammock
10 – shrub plantings and landscape trees; mulched areas near buildings and lawns
5 – wet hardwood hammocks that do not flood regularly
3 – open, recently burned sandhill
2 – swamp forest
2 – pine flatwoods
2 – tropical pine rocklands
1 – marsh tussocks

The litter samples used in this study were indexed by site and date. Out of 908 samples that were collected at a site and date where *Q. emmae* was found, 227 (exactly 25%) contained *Q. emmae*. The percentage at particular sites and dates varies, but overall where *Q. emmae* occurs it is a common species.

We made a list of ants for each of the 227 litter samples that contained *Q. emmae.* This list shows that *Q. emmae* almost always occurs with other species of ants, with which it must be compatible and with which it must share microhabitat requirements. There were 15 samples with no other ant species; 40 with 1 other ant species; 64 with 2 other ant species; 45 with 3 other ant species; 33 with 4 other ant species; 21 with 5 other ant species; 8 with 6 other ant species; and 1 with 7 other ant species. The list of species and the number of times that they occurred together with *Q. emmae* is in Table 1; included in this table is an indication of which species are exotics and which are dacetine ants.

Two colonies of *Q. emmae* were examined. One was in a hollow acorn in leaf litter in a mesic forest at Spruce Creek Preserve, Volusia Co.; this nest had one

Table 1. Species of ants found together with *Q. emmae* in 227 small litter samples. Exotics denoted by asterisk (*). Other dacetines denoted by plus sign (+).

No. of Co-occurrences	Species
99	*Solenopsis abdita* Thompson
74	*+*Strumigenys eggersi* Emery
70	*Solenopsis tennesseensis* Smith
53	*Hypoponera opacior* (Forel)
40	*Brachymyrmex depilis* Emery
31	**Wasmannia auropunctata* (Roger)
26	*Pheidole dentigula* Smith **P. moerens* Wheeler
21	*Pheidole floridana* Emery
14	*Paratrechina wojciki* Trager
13	*Cyphomyrmex minutus* Mayr +*Strumigenys louisianae* Roger
10	*Solenopsis nickersoni* Thompson
9	**Pheidole flavens* Roger
8	**Odontomachus ruginodis* Smith
7	*Odontomachus brunneus* (Patton)
5	+*Smithistruma talpa* (Weber), *+*Strumigenys rogeri* Emery
4	*Aphaenogaster miamiana* Wheeler, *Eurhopalothrix floridana* Brown & Kempf, **Paratrechina guatemalensis* (Forel), *Pheidole dentata* Mayr,*+*Strumigenys gundlachi* (Roger)
3	**Hypoponera punctatissima* (Roger), *Paratrechina faisonensis* (Forel), *Pheidole metallescens* Emery, +*Smithistruma ornata* (Mayr), *Solenopsis geminata* (Fabricius), *+*Trichoscapa membranifera* (Emery)
2	*Aphaenogaster treatae* Forel, *Hypoponera opaciceps* (Mayr), *Monomorium floricola* (Jerdon), +*Smithistruma creightoni* (Smith), +*S. dietrichi* (Smith), *Solenopsis carolinensis* (Forel),**Solenopsis invicta* Buren, **Tapinoma melanocephalum* (Fabricius).
1	*Amblyopone pallipes* (Haldeman), *Aphaenogaster ashmeadi* (Emery), *A.fulva* Roger, *Camponotus floridanus* (Buckley), **Cardiocondyla emeryi* Forel, **C. wroughtonii* (Forel), *Crematogaster lineolata* (Say), **Cyphomyrmex rimosus* (Spinola), *Discothyrea testacea* Roger, *Hypoponera inexorata* (Wheeler), *Leptothorax torrei* (Aguayo), *Monomorium viride* Brown, *Myrmecina americana* Emery, *Odontomachus clarus* Roger, **Paratrechina bourbonica* (Forel), *P. concinna* Trager, **P. longicornis* (Latreille), **Tetramorium caldarium* (Roger), **T. simillimum* (Smith), *Trachymyrmex septentrionalis* (McCook)

queen, 14 workers, and brood. A second colony was found in a hollow, buried acorn of *Quercus chapmanii* in xeric scrub forest at the Archbold Biological Station, Highlands Co. This colony had one queen, 42 workers, and brood. When the acorn from Highlands Co. was opened, there was one dead, white mite with one leg detached, and a shriveled entombryid collembolan that was being eaten by a larva. This colony was offered a wide variety of living soil organisms sifted from leaf litter, and the next day there were 7 dead entomobryids in the colony inside the acorn, including one collembolan that was being eaten by a larva. The next day two larvae were seen feeding on entomobryids. It appears that entomobryid Collembola are a preferred prey of *Q. emmae.*

SUMMARY OF POSSIBLE ECOLOGICAL IMPACTS OF *Q. EMMAE*

Quadristruma emmae has colonized all of southern and south-central Florida, where it is a common species in a variety of xeric and mesic habitats. To those of us who are concerned about the integrity of southern Florida's natural communities, it should be particularly disturbing that *Q. emmae* seems to regularly invade natural communities. In these natural communities *Q. emmae* could be having two undesirable effects: 1) changing the population structure of native prey species, and 2) displacing native species, especially other species of dacetine ants, that feed on Collembola. For the first, there is no evidence of any sort; we do not even know whether the prey are themselves native species; for all we know *Q. emmae* could be helping to restore a balance between exotic and native Collembola. For the second, we have the evidence of co-occurring species (Table 1), from which it can be seen that *Q. emmae* seldom occurs with any other species of dacetine ant, except for *Strumigenys eggersi* Emery, which is itself an even more pervasive exotic, originating in the Neotropics. The known native dacetine ants of Florida consist of *Strumigenys louisianae* Roger and at least 21 species of *Smithistruma*. There is excellent evidence from our unpublished collecting data that most species of *Smithistruma* are more northern, and become scarce well before the northern edge of the range of *Q. emmae* or *S. eggersi.* There are several species of *Smithistruma* that have ranges that extend into south-central Florida in swamp forest and wet hammock areas, but these are not favored habitats for *Q. emmae* (though they have been invaded by another exotic dacetine, *Strumigenys rogeri* Emery). The species most likely to have been affected in south-central Florida are *Smithistruma talpa* (Weber), *S. creightoni* (Smith), and *S. dietrichi* (Smith), all of which occur in xeric forest. In more mesic sites, *S. ornata* (Mayr) and *Strumigenys louisianae* might be displaced by *Q. emmae,* in combination with *S. eggersi.* In tropical Florida there is no evidence that there were ever any native dacetines other than *Strumigenys louisianae* and *Smithistruma dietrichi.* There are records of these species from the 1960's, and both species still occur in the Florida keys (Deyrup et al. 1988), although they are rare. To summarize, *Q. emmae* and other exotic dacetine ants

have invaded south and south-central Florida on a grand scale, and there is a good chance that they have displaced, or are displacing, native species of dacetines that are northern in origin and less well adapted to tropical and subtropical conditions. At this point, however, we do not seem to be facing the prospect of the displacement of any Florida species of dacetine ant throughout or beyond its range in Florida.

Although one might go to almost any ecological preserve in southern Florida and immediately find large numbers of *Q. emmae* or other exotic dacetines polluting what appear to be natural communities, there is no reason to suspect that these natural communities are about to collapse, beginning with the soil microfauna. Our samples show that many native litter-inhabiting ants seem to be compatible with *Q. emmae* (Table 1). Moreover, although the litter fauna is an important component of natural ecosystems, the soil community itself can be considered a mass of subsystems, and the dacetine-collembolan interaction is only part of one subsystem. One of the features of highly complex biological systems is their resilience in the face of minor pollutants; another feature, however, is that the limitations of this resilience are usually unknown, and we are none too sure of what we can legitimately characterize as a "minor" pollutant.

THE MALE OF *Q. EMMAE*

The male of *Q. emmae* is undescribed. We did not find males in the nests that we have examined. We found, however, three males in flight traps at the Archbold Biological Station that we believe represent this species (Fig. 3) for the following reasons. 1). Morphological correlates with the female. The mandibles of these males are strongly bowed, notched at the base, and tilted upward, as in the female and the worker (Fig. 1); these are not character states known from other North American dacetines. The rare exotic *Epitritus hexamerus* Brown (not known from the Archbold Biological Station) also has bowed mandibles in the worker, but the males that we take to be *Q. emmae* are considerably smaller (total length 1.45 mm; length of forewing 1.85 mm) than one would expect for *E. hexamerus* males (the male of this species is unknown). The forewings closely resemble those of the female, including the development of the stigma, the length and width of the radial spur and the development of its distal knob, and the density of setation on various parts of the wing. 2). There are no other dacetines that can be associated with these males at the Archbold Biological Station, a site that has probably been more intensively sampled for dacetines than any other site of comparable size in Florida. Of the dacetines known from the Station, we have seen Florida specimens with associated males of *Strumigenys louisianae*, *Smithistruma dietrichi*, *S. ornata*, and *S. talpa*. The male of *S. clypeata* is described by Brown (1953); males of *S. creightoni* were examined by Brown (1964), who probably would have mentioned any aberrant development of the mandibles; and we have seen some large, unassociated

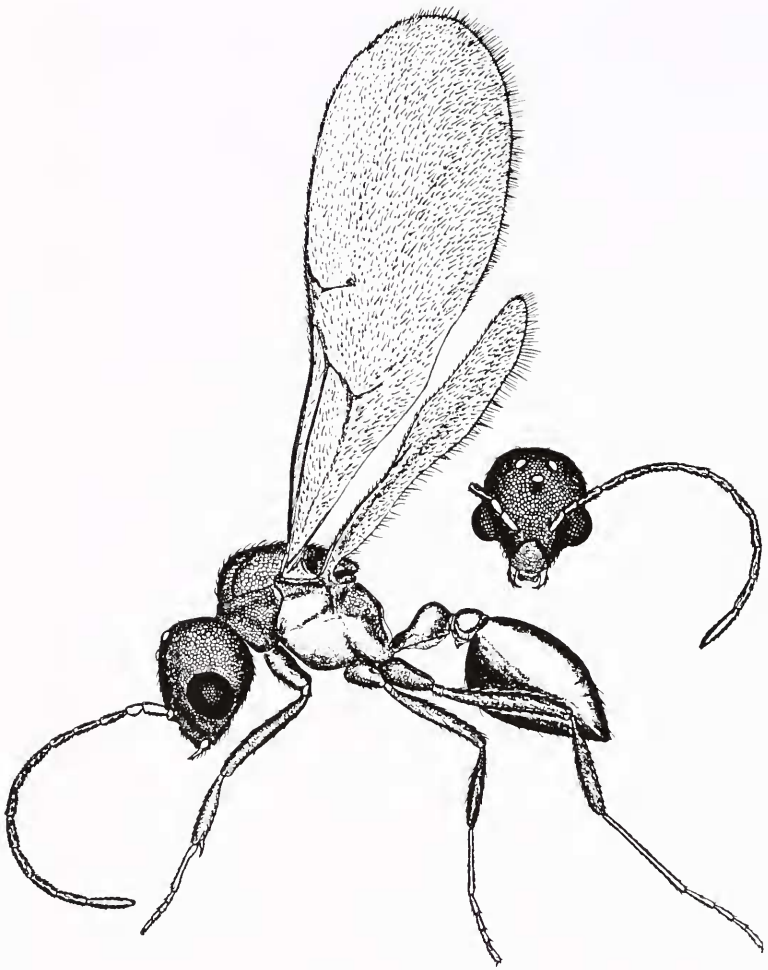

Figure 3. Presumed male (unassociated) of *Quadristruma emmae*.

males that are probably the males of *Strumigenys rogeri*. The males of the two remaining species, *Strumigenys eggersi* and *Trichoscapa membranifera* (Emery), are unknown, but if these specimens were males of either of those species we would be forced to assume that the male mandibles had evolved in a divergent and specialized way, rather than being feeble and probably functionally insignificant reflections of female and worker mandibular development (e.g., the male mandibles of *Smithistuma rostrata* (Emery), illustrated in Brown 1953).

The three males were collected in 1986 on July 25, 28, and Dec. 29, in Townes-style Malaise traps set up on a trail in dense sand pine scrub habitat. Over a period of three years, seven alate females were collected in these same traps, and four of these females were collected on July 14, 24, and 28 in 1986, so there is some coincidence in the flight activity of female *Q. emmae* and the presumed male of the species.

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